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# Design and Criticality Considerations for 9977 and 9978 Shipping Packages

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# **Design and Criticality Considerations for 9977 and 9978 Shipping Packages**

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## **SUMMARY**

Savannah River National Laboratory (SRNL) has developed two new, Type B, state-of-the-art, general purpose, fissile material Shipping Packages, designated 9977 and 9978, as replacements for the U.S. DOT specification 6M container, phased out in September 30, 2008 due to non-compliance with current requirements 10CFR71 regulation. The packages accommodate plutonium, uranium and other special nuclear materials in bulk quantities and in many forms with capabilities exceeding those of the 6M.

These packages provide a high degree of single containment and comply with 10CFR71, Department of Energy (DOE) Order 460.1B, DOE Order 460.2, and 10CFR20 (As Low As Reasonably Achievable (ALARA)).

Allowed package contents were determined accounting for nuclear criticality, radiation shielding, and decay heat rate. The Criticality Safety Index (CSI) for the package is 1.0. The package utilizes passive cooling to maintain internal temperatures within limits. Radiation shielding analyses have established the contents for which the packages can be shipped under *non-exclusive use* in the Safe-Secure Trailer or under *exclusive use*.

## **DESCRIPTION**

The packages are designed to ship radioactive contents in several configurations; Radioisotope Thermoelectric Generators (RTGs), nested food-pack cans, site specific containers, and DOE-STD-3013 containers.

Each shipping package includes a 35-gallon stainless steel outer drum, insulation, a drum liner, and a single containment vessel (CV). The 9977 includes a 6-inch ID CV while the 9978 includes a 5-inch ID CV.

One inch of Fiberfrax® insulation is wrapped around and attached to the sides and bottom of the liner. The volume between the Fiberfrax® and the drum wall is filled with polyurethane foam.

Top and bottom aluminum Load Distribution Fixtures (LDFs) within the drum liner cavity, above and below the CV, center the CV in the liner, stiffen the package radially, and distribute loads away from the CV. The 6CV fits directly into the LDFs while honeycomb spacers position the 5CV in the LDFs.

## **CRITICALITY EVALUATION**

Criticality control design features of the 9977 and 9978 include loading of fissile material contents into the CV and the drum, which maintains spacing between contents. There are no other criticality control design features, (e.g., neutron absorbers, flux traps, spacers).

A nuclear criticality safety evaluation demonstrates the safe configurations of the new shipping container for plutonium and uranium metal/oxide loading under various conditions for the Safety Analysis Report for Packaging (SARP). The evaluation is in compliance with the performance requirements of 10CFR, specifically 10CFR71.55 and 71.59.

Details of the criticality evaluation will be discussed in the full paper.